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Introduction

Observations of the shark-directed bottom longline fishery in the Atlantic Ocean and Gulf of Mexico have been conducted since 1994 (e.g. Hale et al. 2012 and references therein). Currently about 198 U.S. fishers are permitted to target sharks (excluding dogfish) in the Atlantic Ocean and Gulf of Mexico, and an additional 252 fishers are permitted to land sharks incidentally. Amendments to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan implemented a shark research fishery, which allows NMFS to select a limited number of commercial shark vessels on an annual basis to collect life history data and catch data for future stock assessments (NMFS, 2007). Specifically, only commercial shark fishers participating in the research fishery are allowed to land sandbar sharks, *Carcharhinus plumbeus*, and must carry an observer on 100% of all trips (compared to a target coverage level of 5-10% outside the research fishery). Outside the research fishery, fishers are permitted to land 36 non-sandbar large coastal sharks per trip (including blacktip shark, *Carcharhinus limbatus*, bull shark, *Carcharhinus leucas*, lemon shark, *Negaprion brevirostris*, nurse shark, *Ginglymostoma cirratum*, silky shark, *Carcharhinus falciformis*, spinner shark, *Carcharhinus brevipinna*, tiger shark, *Galeocerdo cuvier*, great hammerhead shark, *Sphyrna mokarran*, scalloped hammerhead shark, *Sphyrna lewini*, and smooth hammerhead shark, *Sphyrna zygaena*).

Herein, we report on fishing activities in the bottom longline fishery for the 2014 fishing season, including coverage of the 2014 Shark Research Fishery.

Methods

In October 2013, NMFS announced its request for applications for the Shark Research Fishery from commercial shark fishers with a directed or incidental permit for 2014. Commercial

shark fishers submitted applications to the Highly Migratory Species (HMS) Management Division. The HMS Management Division provided a list of qualified applicants to the Panama City Laboratory and based on the temporal and spatial needs of the research objectives, the availability of qualified applicants, available funding and the available quota, five (5) qualified applicants were selected for observer coverage. These vessels carried observers on 100% of trips. Observer coverage outside the shark research fishery depended on the time of year, available funding and fishing seasons. Vessels were randomly selected for coverage if they possessed a valid directed shark permit, and reported fishing with longline gear in the previous year. Target observer coverage for these vessels is 5-10% of trips. There are three fishing regions designated for observer coverage: northern Atlantic, southern Atlantic and Gulf of Mexico. References to the “northern Atlantic” refer to the coastal waters off the eastern U.S. states from Maine to Virginia, the “southern Atlantic” refers to the coastline from North Carolina to Florida, and the “Gulf of Mexico” refers to the coastline from the Florida Keys to Texas. Because no vessels fished the previous year in the northern Atlantic, vessels were selected from two fishing regions: southern Atlantic and Gulf of Mexico.

Selection letters requiring observer coverage were issued to the permit holder via U.S. Certified mail approximately one month prior to the upcoming fishing season. Once the permit holder receives the selection letter, he or she is required to make contact with the observer coordinator and indicate intent to fish during the upcoming fishing season. If the permit holder intended to fish, the observer coordinator deployed an observer to the port of departure. Vessels were required to pass a Coast Guard Vessel Safety Examination as well as a safety evaluation by the observer prior to coverage.

While onboard the vessel, the observer completes three data forms: Longline Gear Log, Longline Haul Log, and Animal Log. The Longline Gear Log is used to record gear characteristics. The Longline Haul Log is used to record the information on set and haulback, as well as environmental information. The Animal Log records all species caught, condition of the catch (e.g. alive, dead, damaged, or unknown), and the final disposition of the catch (e.g. kept, released alive, discarded dead, etc.).

In 2012, HMS Management Division changed the regulations for Shark Research Fishery trips to minimize unnecessary discard of dead sharks. Participants were allowed to harvest all non-prohibited species of sharks, including sandbar sharks only when an authorized sampler was onboard and the fishery was open. Fishers were required to land all catch of shark species that were legal under a directed shark permit (including sandbar shark, which is otherwise prohibited) unless they could be released alive. In 2014, HMS continued the 2012 amended model which allows one 150 hook ‘feeler’ set with a soak time of no more than two hours and one 300 hook set with no soak limit. A bycatch quota of three (3) dead dusky shark interactions per region was implemented for each of the five fishing regions (Figure 1). Every vessel had the option to move between regions to allow some flexibility for the fisherman to avoid seasonal dusky shark areas where catches were high. The number of hooks permitted on board was also increased to account for any lost hooks during a feeler set and provide fishermen flexibility to use different types of hooks while fishing for non-HMS species within the same trip. After the observation of three dead dusky sharks within a specified region, new guidelines were enforced to decrease dusky shark mortality. The new guidelines limit all permit holders to one 300 hook set per trip with a soak time no more than 3 hours. If three additional dusky shark interactions (alive or dead)

occur, the region would be completely closed to fishing for the remainder of the year unless otherwise permitted by HMS.

Observers continued to randomly sample sharks for biological samples for updates to life history studies. Vertebrae were collected from sandbar shark, blacktip shark and other select species to maintain time series of age distribution from within the fishery. Increased sampling of vertebrae and reproductive tissue of blacktip sharks occurred to aid with upcoming assessments. Observers were still required to obtain trip weigh out forms which were compared to shark dealer reports by quota monitoring personnel to manage the sandbar shark quota within the research fishery.

Results and Discussion

From March to December 2014, a total of 94 trips (defined as from the time a vessel leaves the port until the vessel returns to port and lands catch, including multiple hauls therein) on 8 vessels with a total of 126 bottom longline hauls (defined as setting gear, soaking gear for some duration of time, and retrieving gear) were observed (Table 1). The Shark Research Fishery commenced with five participants, however in July, a vessel withdrew from the fishery with its remaining quota divided up between the four remaining participants. Gear characteristics of trips varied by area (eastern Gulf of Mexico or southern Atlantic) and target species (non-sandbar large coastal shark, or sandbar shark). For the Shark Research Fishery, if less than three vessels fished in each area then the observed data were summarized for the eastern Gulf of Mexico and southern Atlantic to protect vessel confidentiality. The data were grouped into two groups: a) Shark Bottom Longline Fishery trips in the southern Atlantic, and b) Shark Research Fishery trips in the Gulf of Mexico and southern Atlantic (Figure 2). No trips were observed in the northern Atlantic region.

a) Shark Bottom Longline Fishery - southern Atlantic

i) Gear and haul characteristics

There were 22 hauls on 14 trips observed targeting coastal sharks in the southern Atlantic. Trips averaged 1.9 days in length. The mainline length ranged from 0.9 to 12.0 km with an average of 7.2 km. The bottom depth fished ranged from 3.0 to 21.0 m with an average of 16.4 m, and the number of hooks ranged from 47 to 401 hooks with an average of 289 hooks fished. The most commonly used hook was the 18.0 circle hook (63.6%). There were six hauls (27.2%) that employed a 16.0 circle hook and two hauls (9.2%) that employed a 12.0 circle hook. The predominant bait used was mullet (68.2%). The average soak duration was 7.8 hr.

ii) Catch and bycatch

There were 1866 individual animals caught on observed bottom longline hauls in the southern Atlantic (Table 2). Sharks comprised 99.4% of the catch, teleost 0.5%, and batoids 0.1%. Small coastal shark species comprised 80.5% of the shark catch, large coastal shark species (excluding sandbar shark) comprised 18.3%, and sandbar sharks comprised 1.0%. Three (3) sand tiger sharks *Carcharias taurus*, were observed caught. Red drum, *Scianops ocellatus*, and gafftopsail catfish, *Bagre marinus*, were the only species of teleost caught (0.5%) and Atlantic sharpnose, *Rhizoprionodon terraenovae*, was the most frequently caught species of shark (69.1%). Length frequencies of shark species are presented in Figure 3.

iii) Protected species interactions

No protected species were observed caught in the Shark Bottom Longline Fishery.

b) Shark Research Fishery

i) Gear and haul characteristics

There were 104 hauls on 79 trips observed in the Shark Research Fishery in the eastern Gulf of Mexico and the southern Atlantic. All of the trips targeted sandbar shark. Trips averaged 1.6 days in length. The mainline length ranged from 2.0 to 19.6 km with an average of 7.0 km. The bottom depth fished ranged from 4 to 158 m with an average of 31.4 m, and the number of hooks ranged from 112 to 300 hooks with an average of 237 hooks fished. The most commonly used hook was the 18.0 circle hook (51.9%) and 12.0 J hooks (37.0% of hauls). Other hook types used were 20.0 circle hooks, 9.0 J hook, 12.0 J hook and 18.0 circle hook. The predominant baits used were spiny dogfish and little tunny (57.6%). The average soak duration was 5.6 hr.

ii) Catch and bycatch

There were 5,587 individual animals caught on observed bottom longline hauls (Table 3). Sharks comprised 98.5% of the catch, followed by teleosts (0.9%), batoids (0.4%), and miscellaneous fauna such as corals, molluscs, etc (0.1%). Large coastal shark species (excluding sandbar) comprised 30.8% of the shark catch, sandbar shark comprised 51.6% and small coastal shark species comprised 12.0%. Prohibited shark species were also caught including the dusky shark, *Carcharhinus obscurus*, (4.5% of shark catch), and the sand tiger shark (0.9%). Two (2) Caribbean reef shark, *Carcharhinus perezii*, and one (1) white shark, *Carcharodon carcharias*, were observed. Red grouper, *Epinephelus morio*, was the most frequently caught species of teleost (0.3 %) and sandbar shark was the most frequently caught species of shark (50.9%). Length frequencies of shark species are presented in Figure 4.

iii) Protected species interactions

Interactions with protected resources were observed for bottom longline vessels fishing in the Gulf of Mexico and southern Atlantic (Table 3). Five (5) smalltooth sawfish, *Pristis pectinata* were observed and released alive. Seven (7) loggerhead sea turtles, *Caretta caretta*, were observed, five (5) released alive and two (2) released dead. There were no sea bird or marine mammal interactions observed.

There were no major changes made to the Shark Research Fishery in 2014 but some minor adjustments to the regional dusky shark quota were examined. The regional dusky catch limit was designed to reduce the impact of this fishery on the dusky shark. In 2013, the new regulation did produce a decline in interactions (24 sharks from 93 hauls; 0.7% of the shark catch), but resulted in a loss of fishing activity from all months in all regions (Gulak et al. 2014). The dusky shark quota did not reduce dusky catch similar to the previous year as dusky sharks accounted for 4.5% of shark catch. However, the southern Atlantic region was closed in October. The Highly Migratory Species Management Division amended the original permits to reallocate dusky sharks from regions with no dusky shark take, (i.e. North Atlantic and West coast of Florida regions), to reopen the southern Atlantic. The Highly Migratory Species Management Division also allocated the North Carolina region, an area known for higher dusky shark interactions in previous years, more dead dusky shark quota so that fishing could continue. All vessels fishing in the North Carolina or southern Atlantic region for the remainder of the year were limited to one main set with the soak time not to exceed 3 hours. Sampling in this area allowed for four (4) dusky sharks to be tagged with satellite pop-up archival transmitting (PAT) tags. Information gathered through this project is being used to evaluate the utility of the closed area off North Carolina and determine post-release survivorship for dusky sharks. In addition,

twenty-three (23) conventional dart tags were deployed on dusky sharks. This research is scheduled to continue in 2015.

The Shark Bottom Longline Observer Program collect and provide vital data on temporal and spatial catch, release mortality, bycatch species, and updates to quota monitoring. Continued observer funding will permit the program to maintain this important time series.

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Table 1. Number of vessels, trips, hauls, and hook hours observed in the Gulf of Mexico and south Atlantic Ocean.

Fishery	Vessels Observed	Trips Observed	Hauls Observed	Hook Hours
Shark Bottom Longline Fishery	3	14	22	3057.3
Shark Research Fishery	5	80	104	158734.9
Total	8	94	126	161792.2

Table 2. Number caught (n) and disposition of catch in percentage for all observed hauls in the Shark Bottom Longline Fishery. Disposition of catch is divided into kept (K), discard dead (DD), discard alive (DA), and unknown (U).

Scientific name	Common Name	n	% K	% DD	% DA	% U
<i>Rhizoprionodon terraenovae</i>	Atlantic sharpnose shark	1281	5.1	84.1	10.9	0.0
<i>Carcharhinus limbatus</i>	Blacknose shark	282	84.8	14.9	0.4	0.0
<i>Carcharhinus acronotus</i>	Blacktip shark	196	4.1	85.7	9.7	0.5
<i>Galeocerdo cuvier</i>	Tiger shark	21	81.0	0.0	14.3	4.8
<i>Carcharhinus plumbeus</i>	Sandbar shark	18	11.1	0.0	88.9	0.0
<i>Sphyrna tiburo</i>	Bonnethead shark	16	0.0	100.0	0.0	0.0
<i>Carcharhinus leucas</i>	Bull shark	12	83.3	8.3	0.0	8.3
<i>Bagre marinus</i>	Gafftopsail catfish	8	0.0	0.0	100.0	0.0
<i>Negaprion brevirostris</i>	Lemon shark	8	75.0	0.0	0.0	25.0
<i>Sphyrna lewini</i>	Scalloped hammerhead shark	7	71.4	28.6	0.0	0.0
<i>Carcharhinus brevipinna</i>	Spinner shark	4	0.0	100.0	0.0	0.0
<i>Ginglymostoma cirratum</i>	Nurse shark	4	0.0	0.0	100.0	0.0
<i>Carcharias taurus</i>	Sand tiger shark	3	0.0	0.0	100.0	0.0
<i>Sphyrna mokarran</i>	Great hammerhead shark	2	100.0	0.0	0.0	0.0
<i>Carcharhinus isodon</i>	Finetooth shark	1	0.0	0.0	100.0	0.0
<i>Dasyatis centroura</i>	Roughtail stingray	1	0.0	0.0	100.0	0.0
<i>Rajiformes</i>	Skates and rays	1	0.0	0.0	100.0	0.0
<i>Scianops ocellatus</i>	Red drum	1	0.0	0.0	100.0	0.0

Table 3. Number caught (n) and disposition of catch in percentage for all observed hauls in the Shark Research Fishery. Disposition of catch is divided into kept (K), discard dead (DD), discard alive (DA), and unknown (U).

Scientific Name	Common Name	n	% K	% DD	% DA	% U
<i>Carcharhinus plumbeus</i>	Sandbar shark	2842	98.9	0.0	0.1	1.0
<i>Carcharhinus limbatus</i>	Blacktip shark	741	98.9	0.4	0.1	0.5
<i>Rhizoprionodon terraenovae</i>	Atlantic sharpnose shark	533	17.8	65.7	15.9	0.6
<i>Galeocerdo cuvier</i>	Tiger shark	396	42.7	0.8	55.3	1.3
<i>Carcharhinus obscurus</i>	Dusky shark	250	0.0	13.2	86.8	0.0
<i>Sphyrna lewini</i>	Scalloped hammerhead shark	155	90.9	2.6	6.5	0.0
<i>Ginglymostoma cirratum</i>	Nurse shark	137	0.0	0.0	100.0	0.0
<i>Carcharhinus acronotus</i>	Blacknose shark	125	27.2	24.8	48.0	0.0
<i>Carcharhinus leucas</i>	Bull shark	108	84.3	0.0	0.0	15.7
<i>Sphyrna mokarran</i>	Great hammerhead shark	74	93.2	1.4	5.4	0.0
<i>Carcharias taurus</i>	Sand tiger shark	48	0.0	0.0	100.0	0.0
<i>Negaprion brevirostris</i>	Lemon shark	39	92.3	0.0	0.0	7.7
<i>Carcharhinus brevipinna</i>	Spinner shark	30	96.7	3.3	0.0	0.0
<i>Carcharhinus falciformis</i>	Silky shark	15	73.3	6.7	13.3	6.7
<i>Epinephelus morio</i>	Red grouper	15	13.3	46.7	40.0	0.0
<i>Dasyatis centroura</i>	Roughtail stingray	12	16.7	0.0	83.3	0.0
<i>Epinephelus itajara</i>	Goliath grouper	8	0.0	0.0	100.0	0.0
<i>Caretta caretta</i>	Loggerhead sea turtle	7	0.0	28.6	81.4	0.0
<i>Scianops ocellatus</i>	Red drum	7	0.0	0.0	100.0	0.0
<i>Carcharhinidae</i>	Requiem shark family	5	0.0	40.0	0.0	60.0
<i>Pristis pectinata</i>	Smalltooth sawfish	5	0.0	0.0	80.0	20.0
<i>Batrachoididae</i>	Toadfish family	4	25.0	0.0	75.0	0.0
<i>Dasyatis americana</i>	Southern stingray	3	0.0	0.0	100.0	0.0
<i>Dasyatis sp.</i>	Stingrays	3	0.0	0.0	100.0	0.0
<i>Lutjanus analis</i>	Mutton snapper	3	66.7	33.3	0.0	0.0
<i>Rachycentron canadum</i>	Cobia	3	100.0	0.0	0.0	0.0
<i>Carcharhinus perezi</i>	Caribbean reef shark	2	0.0	50.0	50.0	0.0
<i>Lutjanus campechanus</i>	Red snapper	2	0.0	100.0	0.0	0.0
<i>Pomatomus saltatrix</i>	Bluefish	2	0.0	100.0	0.0	0.0
<i>Anthozoa</i>	Coral	1	0.0	100.0	0.0	0.0
<i>Bagre marinus</i>	Gafftopsail catfish	1	0.0	0.0	100.0	0.0
<i>Carcharodon carcharias</i>	Great white shark	1	0.0	0.0	0.0	100.0
<i>Echeneis naucrates</i>	Sharksucker	1	0.0	0.0	100.0	0.0
<i>Echinodermata</i>	Sea urchins	1	0.0	0.0	100.0	0.0
<i>Elasmobranchii</i>	Sharks	1	0.0	100.0	0.0	0.0
<i>Mollusca</i>	Molluscs	1	0.0	0.0	100.0	0.0
<i>Muraena retifera</i>	Reticulate moray eel	1	0.0	0.0	100.0	0.0
<i>Porifera</i>	Sponges	1	0.0	100.0	0.0	0.0

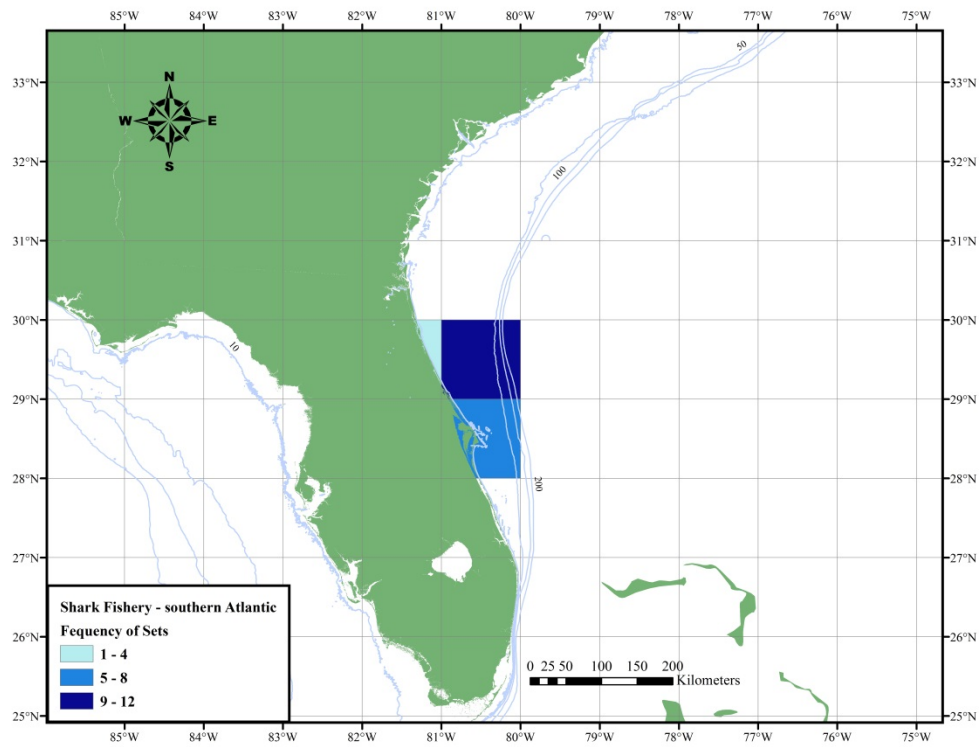
<i>Raja eglanteria</i>	Clearnose skate	1	0.0	0.0	100.0	0.0
<i>Rajiformes</i>	Skates and rays	1	0.0	0.0	100.0	0.0
<i>Scorpaenidae</i>	Scorpionfish family	1	0.0	100.0	0.0	0.0
<i>Triakidae</i>	Houndsharks	1	0.0	0.0	100.0	0.0

Figure 1. Dusky shark bycatch quota regions



Figure 2. Distribution of all observed hauls by target in 2013. (a) Distribution of effort for the Shark Bottom Longline Fishery, (b) distribution of effort for the Shark Research Fishery.

(a)



(b)

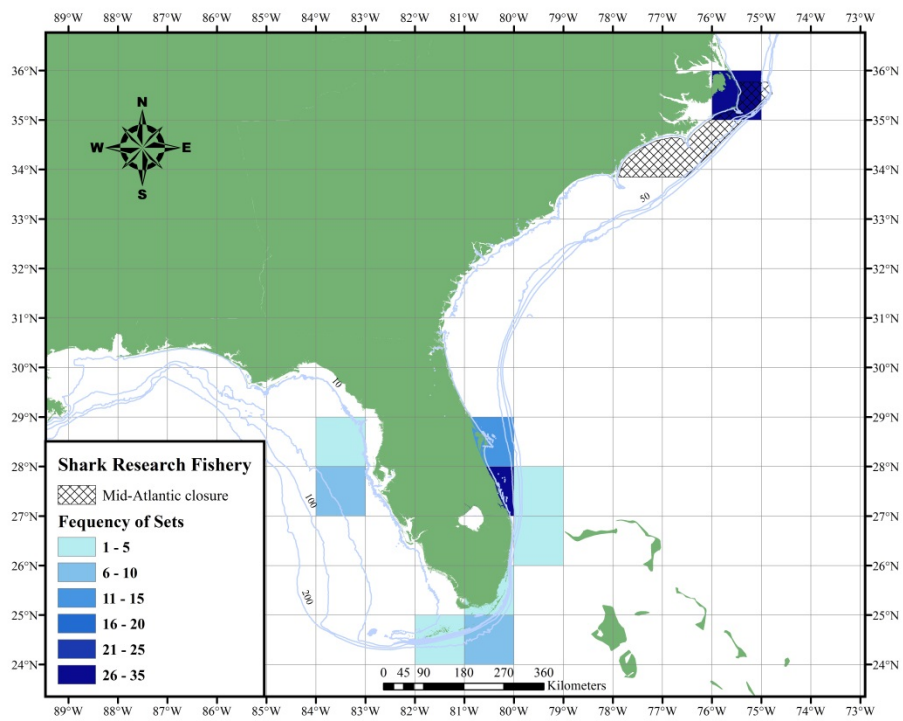
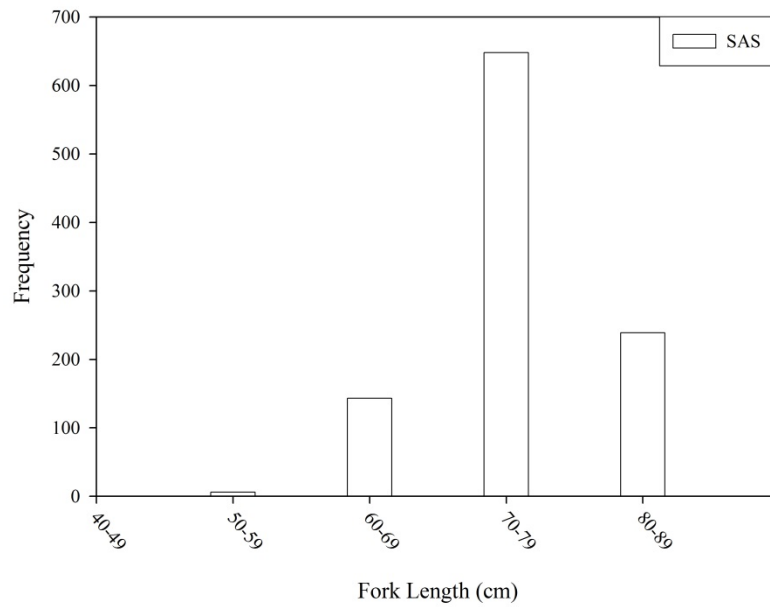


Figure 3. Length frequency (cm fork length) of (a) Atlantic sharpnose (SAS) sharks, (b) bonnethead (BHH) and blacknose (SBN) sharks observed caught on bottom longline sets in the Shark Bottom Longline Fishery.

(a)



(b)

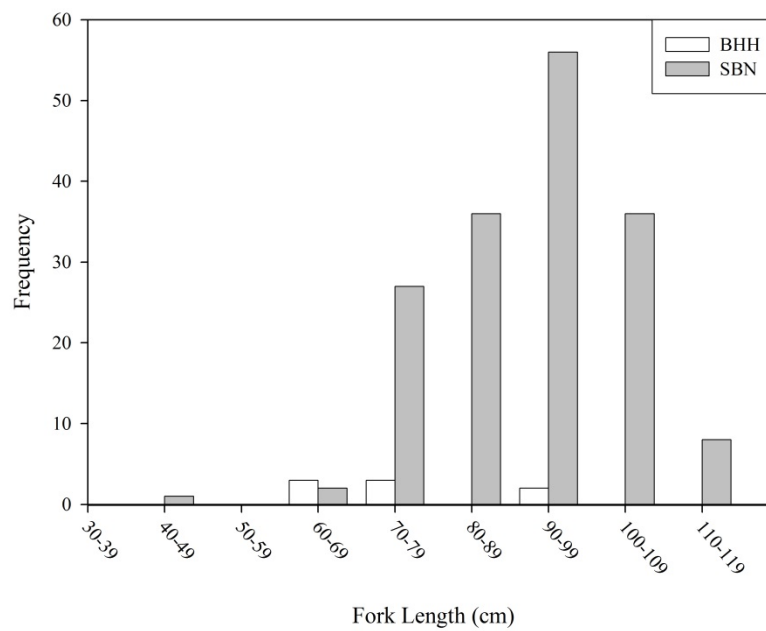
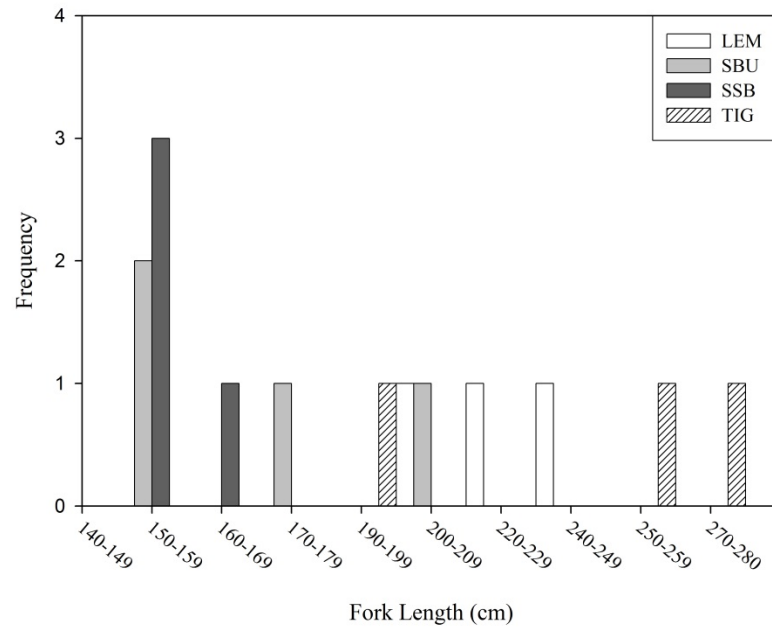


Figure 3 cont'd. Length frequency (cm fork length) of (c) lemon (LEM), bull (SBU), sandbar (SSB) and tiger (TIG) sharks, (d) great hammerhead (GHH), scalloped hammerhead (SPL) and spinner (SSP) sharks observed caught on bottom longline sets in the Shark Bottom Longline Fishery.

(c)



(d)

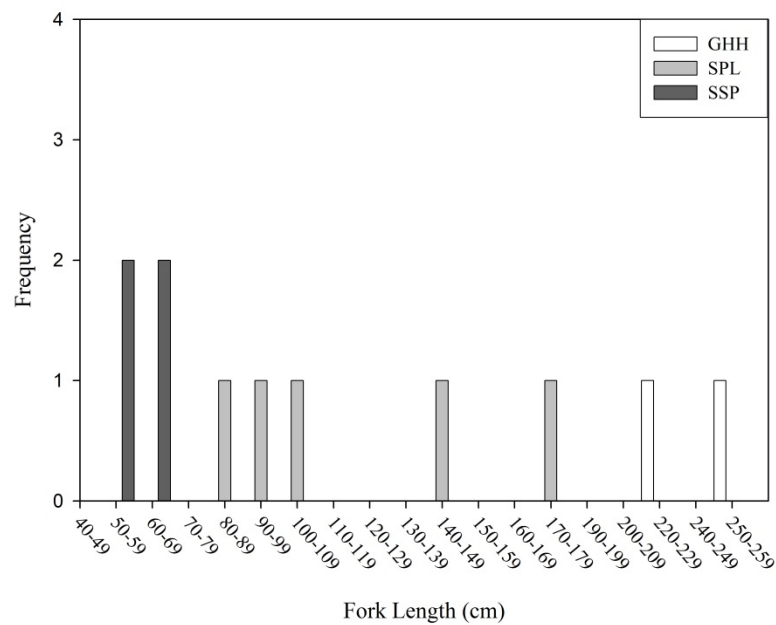


Figure 3 cont'd. Length frequency (cm fork length) of (e) blacktip (SBK) sharks observed caught on bottom longline sets in the Shark Bottom Longline Fishery.

(e)

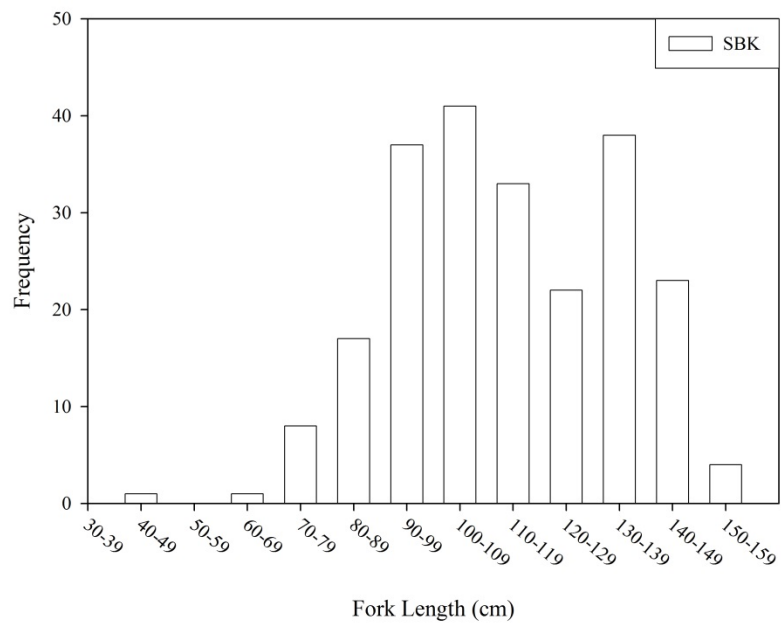
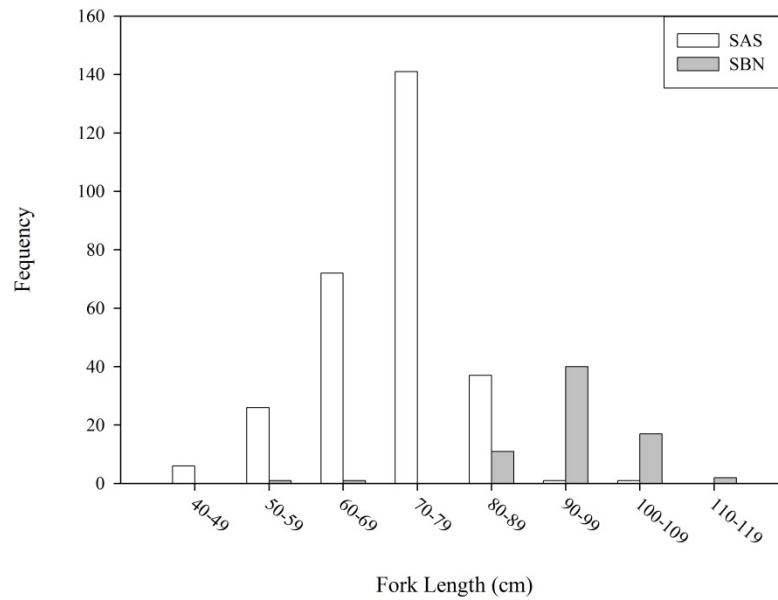


Figure 4. Length frequency (cm fork length) of (a) Atlantic sharpnose (SAS) and blacknose (SBN) sharks, (b) dusky (DUS), silky (FAL) and caribbean reef (SRF) sharks observed caught on bottom longline sets in the Shark Research Fishery.

(a)



(b)

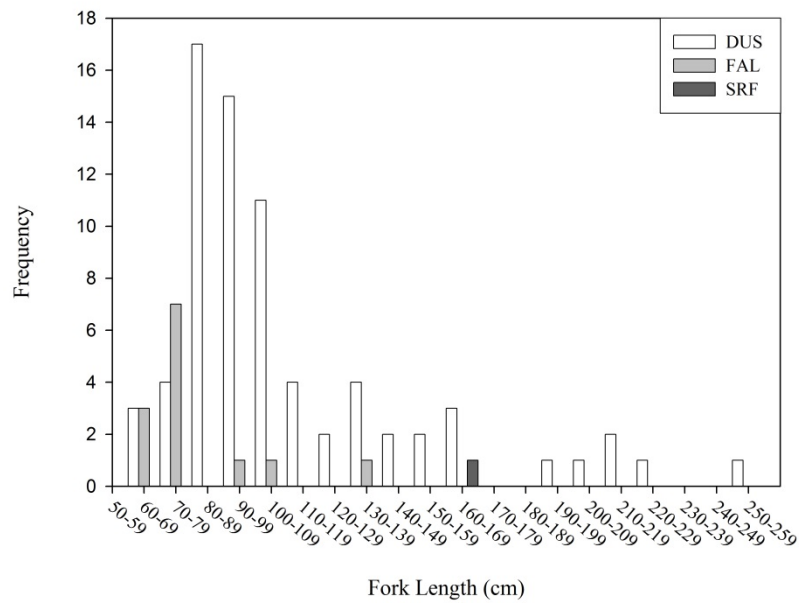
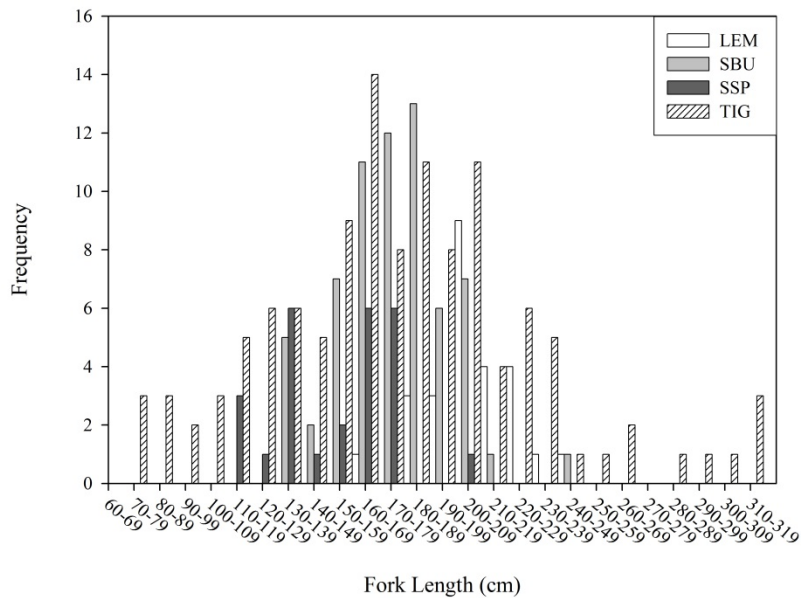


Figure 4 cont'd. Length frequency (cm fork length) of (c) lemon (LEM), bull (SBU) sharks, spinner (SSP) and tiger (TIG) sharks, (d) great hammerhead (GHH) and scalloped hammerhead (SPL) sharks observed caught on bottom longline sets in the Shark Research Fishery.

(c)



(d)

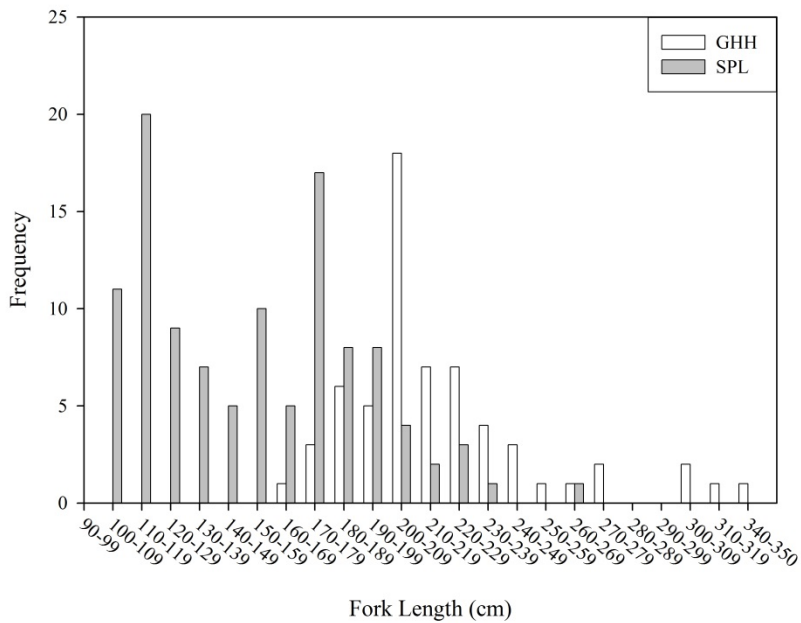
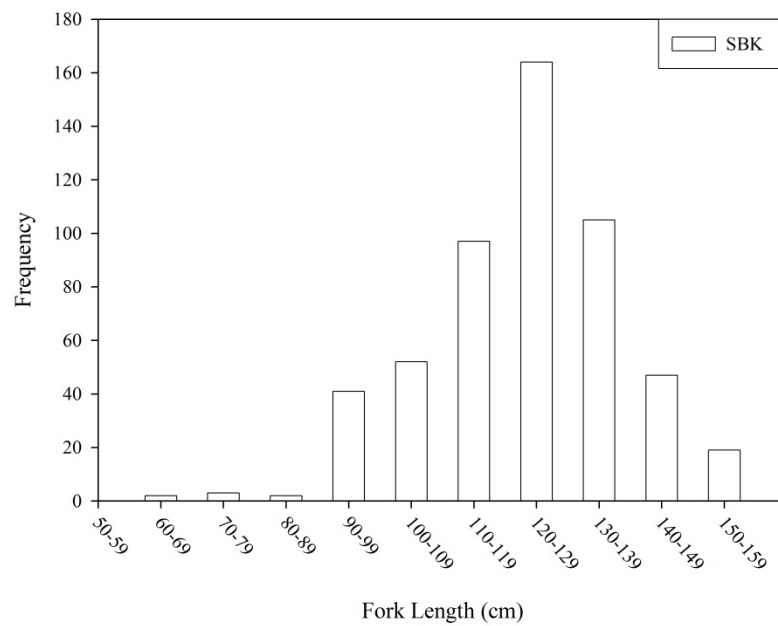


Figure 4 cont'd. Length frequency (cm fork length) of (e) blacktip (SBK) sharks, (f) sandbar (SSB) sharks observed caught on bottom longline sets in the Shark Research Fishery.

(e)



(f)

